Saskatchewan
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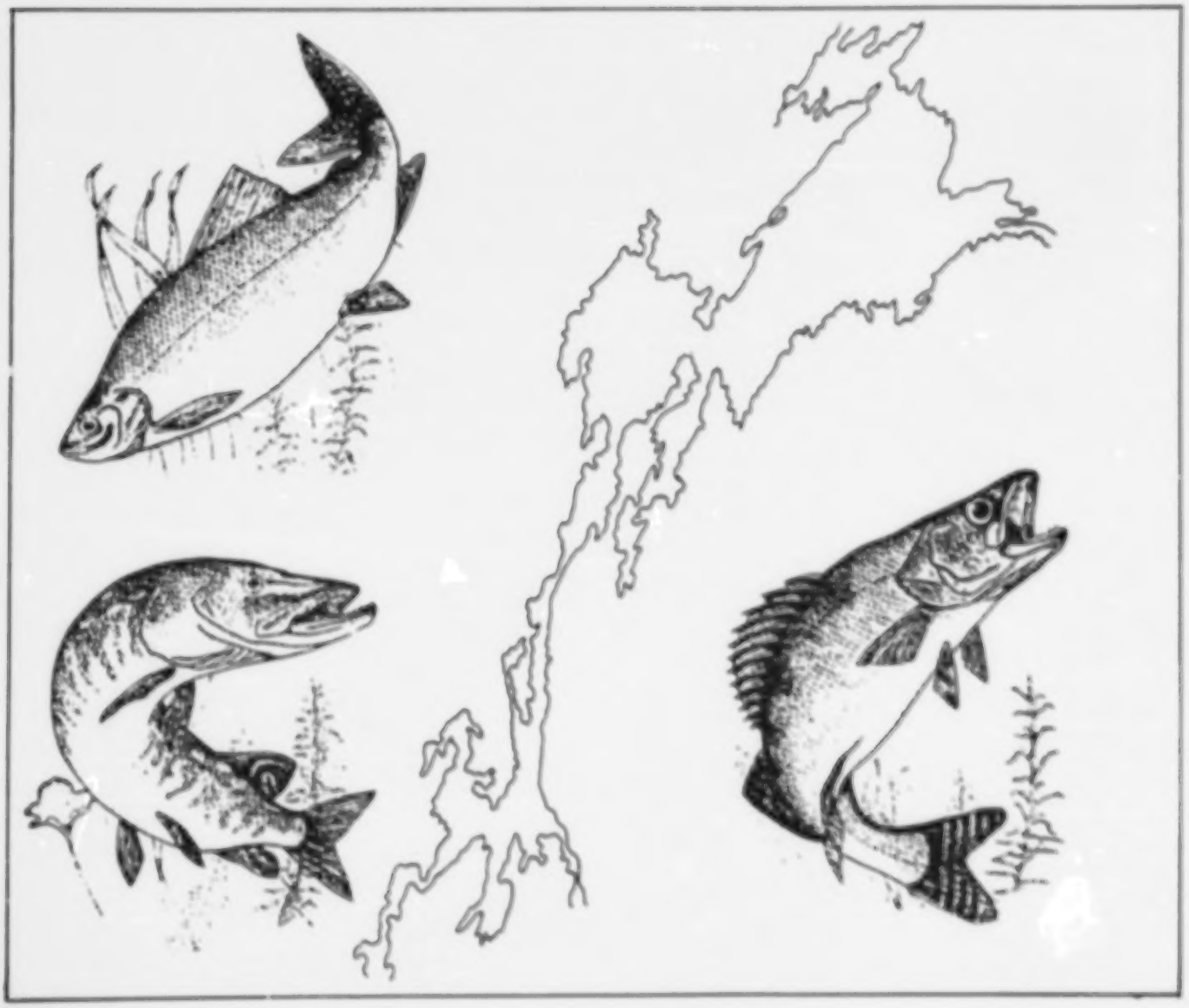
Resources

Northern Lakes Fish Monitoring Program:

Pelican Lake - 1989

Technical Report 91-5



NORTHERN LAKES FISH MONITORING PROGRAM

PELICAN LAKE - 1989

by

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FISHERIES TECHNICAL REPORT 91-5

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EXECUTIVE SUMMARY

A fisheries investigation was carried out on Pelican Lake during the summer of 1989 for the purpose of evaluating the current status of the resource. This report deals with the results from that investigation, compares them to results obtained from a similar study conducted in 1963-64, and makes recommendations about future management options for the Pelican Lake fishery.

Pelican Lake is situated in east central Saskatchewan, approximately midway between La Ronge and Creighton, near the southern border of the Precambrian Shield. It has a drainage area that includes Deschambault Lake, the Wood-Manawan-Chachukew lakes, and Jan Lake. Pelican Lake, itself, has an area of 10 200 ha, a maximum depth of 32 m and a mean depth of 11.6 m.

Eight species of large fish were caught in 12 gillnet sets. Ciscoes were the most abundant and made up 48% of the total catch. Lake whitefish was the second most abundant species, comprising 18% of the total catch. Northern pike and walleye made up 7% and 5%, respectively. Suckers, yellow perch and burbot made up the remainder.

Lake whitefish numbers did not change significantly between 1963-64 and 1989. The majority of fish caught were between 30 cm, and 40 cm in fork length. Ages ranged from 2-12 years, with over 50% of the catch falling into the 4-5 year range. Sexual maturity occurred no later than 5 years of age. The presence of numerous older age classes

suggests that whitefish in Pelican Lake were not heavily harvested in the years preceding the study.

Northern pike was the most abundant gamefish species in Pelican lake. Sizes ranged from 23 cm to 101 cm in fork length, with the majority between 50-65 cm. Ages ranged from 1-9 years of age with 41% of the catch younger than 5 years. The presence of numerous year classes, rapid growth and the large average size suggests this population is being harvested at a sustainable level.

Relative numbers of walleye in Pelican Lake have decreased since the earlier study. The majority of fish caught in gill nets were larger than 30 cm in fork length. Ages ranged from 1-8 years, with 57% of the catch falling into the 3 and 4 year age classes. The absence of old fish, in conjunction with the presence of relatively large young fish indicate heavy exploitation of walleye in Pelican Lake.

Pelican Lake has been subjected to commercial fishing pressure since 1948. Since that time, the number of licenses issued annually has ranged from 2 to 34. The commercial quota is currently 45 400 kg/yr with a 10% tolerance limit on gamefish species. The legal mesh size has always been 11.4 cm. Since the 1960's, annual commercial production has been declining. Within the last decade commercial harvests have been substantially lower than the allowable catch. This has primarily been the result of *Triaenophorus crassus* infestations in the flesh of the whitefish.

Records of Indian harvests are available for 1984-1989, during which time the average annual harvest was 30 600 kg or 3.0 kg·ha $^{-1}$ (63% whitefish, 3.3 % walleye, 6.7% pike, and 27% other species). Angler harvest for 1988 was estimated at 36 720 kg (3.6 kg·ha^{-1}), comprised of 44% walleye and 56% pike.

Based on the estimated maximum sustainable yield of 5.62 kg·ha^{-1} (57 300 kg), annual user harvest in Pelican Lake is excessive. Comparison of actual harvest data and the population data obtained from testnets, however, suggests that whitefish are underutilized, walleye are overutilized, and northern pike are at a sustainable level of utilization.

Recommendations, based on the findings of this report include:

1. Retain the current commercial quota of 45 400 kg and mesh size of 11.4 cm, and restrict nets to depths greater than 10m to reJuce conflict with the sport fishery.
2. Limit the annual recreational harvest of northern pike to 20 500 kg.
3. Reduce daily angling limits on walleye and enforce spring closure to angling in known spawning areas such as Medicine Rapids or Opawikushikan Narrows.
4. Conduct a creel census and native fishery survey to ascertain the impact of these fisheries on the fish resources of Pelican Lake.

ACKNOWLEDGEMENTS

I wish to thank Dr. Bill Sawchyn for initiating the study, Ron Jensen for planning and coordinating the field activities, and his field assistants Bev Pedwell, and Dave Weider. The co-operation of the Regional Resource Officers in Pelican Narrows and Creighton, as well as the local lodge owners is gratefully acknowledged.

A special thank you is extended to Josie Bodnarchuk, who assisted in fish ageing, to J. Merkowsky for her drafting talents, and to Carol Schurr for preparation of the final draft of this report.

Finally, the editorial comments submitted by Dr. W.W. Sawchyn, Dr. A.R. Murray, and J. Durbin are deeply appreciated.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
ACKNOWLEDGEMENTS	iv
1. INTRODUCTION	1
2. DESCRIPTION OF THE STUDY AREA	2
3. METHODS	5
4. RESULTS	7
LAKE WHITEFISH	9
NORTHERN PIKE	17
WALLEYE	25
CISCO	30
YELLOW PERCH	30
UTILIZATION OF THE FISH RESOURCE	31
5. DISCUSSION	36
FISH POPULATIONS	36
LAKE PRODUCTIVITY	42
MANAGEMENT IMPLICATIONS	45
6. SUMMARY AND CONCLUSIONS	47
RECOMMENDATIONS	50
7. LITERATURE CITED	51
8. APPENDICES	53

LIST OF FIGURES

1. Map showing relative location of Jan-Pelican-Mirond Lakes. 3

2. Location of gillnet sets in Pelican Lake in 1963-64 and 1989 (in brackets). 6

3. Frequency distribution of fish species caught per gillnet set in Pelican Lake in 1989 and 1963-64. 10

4. Length frequency distribution of lake whitefish captured in various mesh sizes of gillnet in Pelican Lake in 1963-64 and 1989. 11

5. Weight-length relationships of lake whitefish caught in 12 gillnet sets in Pelican Lake in 1989 (n=393) and 1963-64 (n=415). 14

6. Length frequency distribution of lake whitefish caught in 12 gillnet sets in Pelican Lake in 1989 (n=393) and 1963-64 (n=415). 15

7. Age distribution and growth of lake whitefish caught in 12 gillnet sets in Pelican Lake in 1989 and 1963-64. 18

8. Length frequency distributions of northern pike caught in 12 gillnet sets in Pelican Lake in 1989 (n=154) and 1963-64 (n=92). 20

9. Weight-length relationships of northern pike caught in 12 gillnet sets in Pelican Lake in 1989 (n=154) and 1963-64 (n=92). 21

10. Age distribution and growth of northern pike caught in 12 gillnet sets in Pelican Lake in 1989 (n=145) and 1963-64. 24

11. Length frequency distributions of walleye caught in 12 gillnet sets in Pelican Lake in 1989 (n=112) and 1963-64 (n=199). 26

12. Weight - length relationships of walleye caught in 12 gillnet sets in Pelican Lake in 1989 (n=112) and 1963-64 (n=199). 27

13. Age distribution and growth of walleye caught in 12 gillnet sets in Pelican Lake in 1989 (n=99) and 1963-64. 28

LIST OF TABLES

1. Distribution of depth zones in Pelican Lake (Adapted from Johnson, 1967). 4

2. Summary of fish species caught in 12 gill nets in Pelican Lake in 1963-64 and 1989. (Wt= weight in kg). 8

3. Length weight data for five fish species caught in gill nets in Pelican Lake in 1963-64 and 1989. 13

4. Comparison of ages determined from scales and otoliths collected from lake whitefish caught in 12 gillnet sets in Pelican Lake in 1989. 16

5. Comparison of ages determined from scales and cleithra collected from northern pike caught in gill nets in Pelican Lake in 1989. 23

6. Average commercial fish production (kg x 10^3) in Pelican Lake in each decade since 1948. 33

7. Estimated average annual user harvest (kg) of fish from Pelican Lake from 1984 to 1989. 35

1. INTRODUCTION

A study investigating the fish resources of Pelican Lake was conducted from May 30 to June 21 in 1989. The study was done by personnel from the Saskatchewan Fisheries Laboratory, Fisheries Branch, Saskatchewan Parks and Renewable Resources. A similar study, done in 1963-64, provided comparative baseline data for the current study.

The small community of Pelican Narrows, with a population of approximately 320 people, is located at the northern end of Pelican Lake. In addition, there are currently 5 outfitting camps, including one campground, and one motel situated along the north east side of the lake. Three of the outfitters are open year round. Recreational activities include big game hunting, dog sledding, and fishing.

A commercial fishery on Pelican Lake dates back to 1948. At that time, a 22 700 kg quota included lake whitefish, walleye, northern pike, and lake trout. The current quota of 45 400 kg, with a 10% tolerance limit on gamefish species, was established in 1970 and includes whitefish, pike, and walleye.

The primary objective of this study was to determine the status of the fish resources in Pelican Lake in relation to what it was 25 years ago, and to use the results as a basis for future management decisions.

2. DESCRIPTION OF THE STUDY AREA

Pelican Lake (55°08' 103°00') is located in east central Saskatchewan approximately 120 km west and north of Creighton (Fig. 1). It is the northwestern member of a small, three lake chain, including Jan and Mirond lakes, and is part of the Saskatchewan River drainage basin.

Situated near the southern edge of the Precambrian Shield, Pelican Lake is surrounded by coniferous forest and is underlain by volcanic and sedimentary rock formations, primarily granite (Richards and Fung, 1969). The drainage of Pelican Lake includes Deschambault Lake, the Wood-Manawan-Chachukew Lake area northwest of Pelican Narrows, and Jan Lake.

Pelican Lake has a north/south orientation extending 40 km in length. It ranges in width from 91 m wide at its narrowest point in the South Arm to 2.2 km wide in the northern section, The lake has a water surface area of 10,200 hectares or 100.2 km^2 (Table 1) and roughly 1/3 of that reportedly exceeds 15 m in depth. Average depth of the lake is 11.6 m with a maximum depth of 32 m (Johnson, 1967).

Access to Pelican Lake was originally restricted by lack of road access. In 1967, Hwy #135 was constructed, linking Pelican Narrows to a major transportation route, Hwy #106, (the Hanson Lake Road) at a point approximately 80 km west of Flin Flon, Manitoba and 170 km north of Nipawin Provincial Park, Saskatchewan.

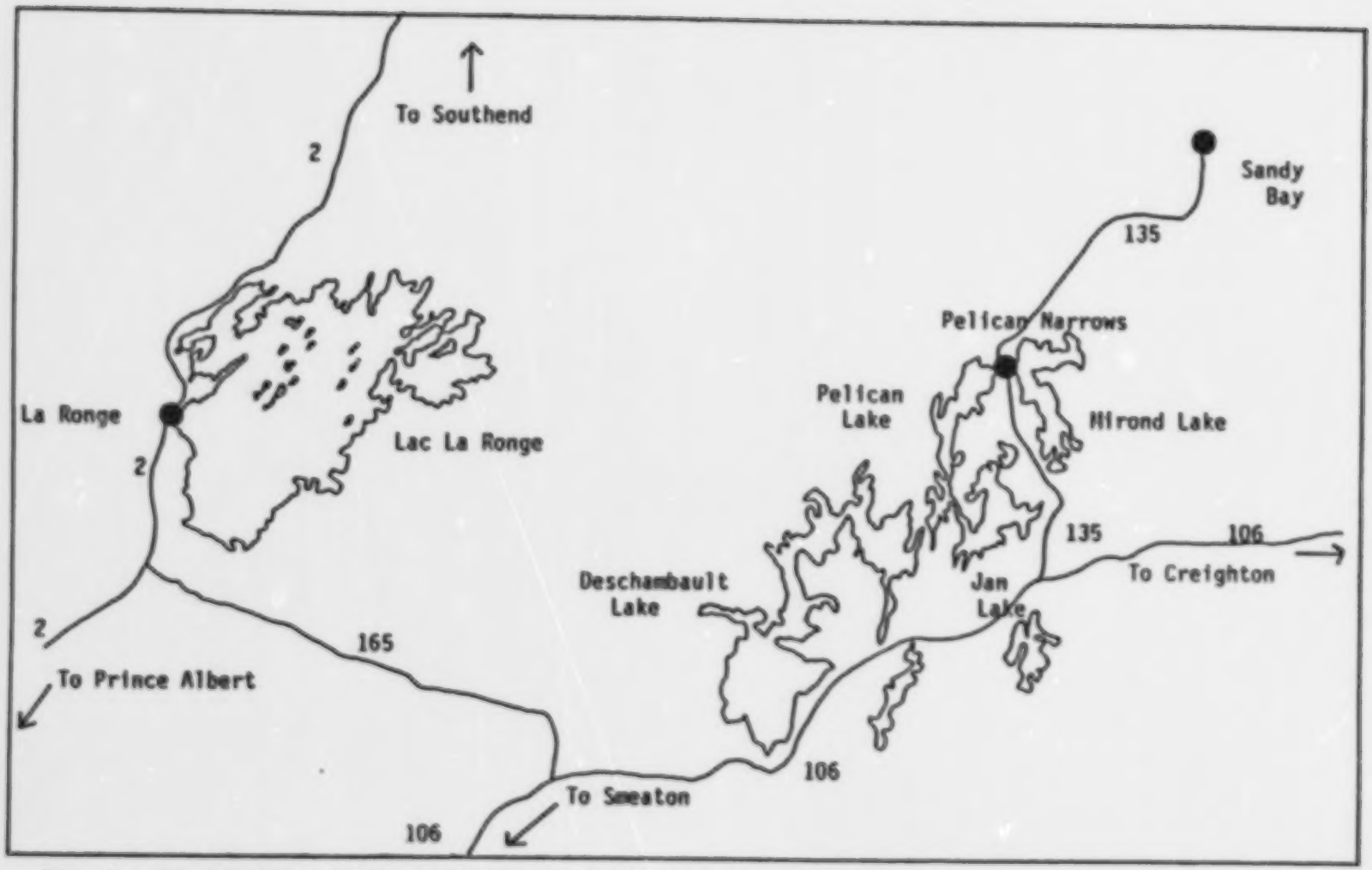

Fig. 1 Map showing relative locations of Jan-Pelican-Mirond Lakes.

Table 1. Distribution of depth zones in Pelican Lake (Adapted from Johnson, 1967).

Depth zone, m	Area		Lake volume	
	km^2	%	$m^3 \times 10^8$	%
0-5	28.46	28.4	4.31	37.1
5-10	25.95	25.9	2.94	25.3
10-15	12.23	12.2	1.99	17.1
15-20	10.52	10.5	1.42	12.2
20-25	15.43	15.4	0.77	6.6
25-30	7.11	7.1	0.19	1.7
30-35	0.50	0.5	*	*
Total	100.20		11.62	

Mean depth, m	11.6
Maximum depth, m	32.0

3. METHODS

Fish species in Pelican Lake were sampled using a standard gang of gill net. The standard gang, which is 276 m in length with 46 m each of 3.8, 5.1, 7.6, 10.2, 12.7, and 14.0 cm mesh sizes, has long been accepted as the standardized measure of relative abundance of populations of larger fish species in Saskatchewan. Each of 12 nets was bottom set for approximately 24 hours after which time it was lifted and picked. An attempt was made tho place the nets in the same locations of the lake as those of 12 nets set in an earlier study conducted in 1963-64 (Fig. 2).

Fork lengths (to the nearest millimetre) and weights (to the nearest gram) were recorded for all individuals of economically important species (i.e walleye, lake whitefish, and northern pike). Sex was determined and state of maturity was defined as immature, mature or, when possible, spent (post spawning). Stomach contents were examined visually in the field. Other fish, including cisco, perch, suckers, and burbot, were counted and maximum and minimum lengths and total weights were recorded. Individual lengths and weights were recorded for a representative sample.

Ageing media were taken from sufficient numbers of fish to provide a representative sample of fork lengths for each recreationally and economically significant species. In addition to scales, which were taken from all the fish, otoliths were obtained from walleye and lake whitefish and cleithra were taken from northern pike. Procedures used

Fig. 2 Location of gillnet sets in Pelican Lake in 1963-64 and 1989 (in brackets).

in the preparation and analyses of these media are described in Musker (1985).

4. RESULTS

Eight species of fish were caught in gill nets in Pelican Lake in 1989. The same species were captured in 1963-64. The average catch per standard gang of gill net showed a decrease from 242.7 fish in 1963-64 to 176.9 fish in the current study (Table 2). The difference was primarily the result of significant decreases in the abundance of ciscoes in the 1989 net catches. Abundance of walleye and yellow perch also decreased but northern pike, burbot, common white sucker, and longnose sucker numbers increased between study years.

Although the total number of fish caught in gill nets in 1989 showed a 27% decrease from that caught in the earlier study, the total weight taken showed only a 13.5% decrease from the total weight caught in 1963-64 (Table 2). In the 1989 study, common white suckers contributed the greatest weight (28%) to the total catch, followed by cisco (23%) and northern pike (21%). Lake whitefish comprised 19% of the total catch weight, and walleye yielded 5%. The remaining 5% was comprised of burbot, longnose suckers, and yellow perch. In 1963-64, cisco contributed the greatest weight (44%) to the total catch for a single species, followed by lake whitefish (22%) and common white suckers (15%). Northern pike ranked fourth heaviest comprising 8% of the total catch weight, while walleye contributed 7% to the total catch.

Table 2. Summary of fish species caught in 12 gill nets in Pelican Lake in 1963-64 and 1989. (Wt = weight in kg).

Species	1963-64		1989	
	No.	Wt.	No.	Wt.
Longnose sucker *Catostomus catostomus*	5 (0.1)[a]	4.3 (0.3)	11 (0.5)	8.7 (0.6)
Common white sucker *Catostomus commersoni*	226 (7)	197.3 (15)	316 (15)	306.6 (28)
Cisco *Coregonus artedii*	1858 (64)	563.9 (44)	1021 (48)	252.7 (23)
Lake whitefish *Coregonus clupeaformis*	415 (14)	287 (22)	393 (18)	211.2 (19)
Northern pike *Esox lucius*	92 (3)	107.6 (8)	154 (7)	233.5 (21)
Burbot *Lota lota*	26 (.9)	23.5 (2)	53 (2)	42.0 (4)
Yellow perch *Perca flavescens*	92 (3)	5.4 (0.4)	63 (3)	4.1 (0.4)
Walleye *Stizostedion vitreum*	199 (7)	94.2 (7)	112 (5)	55.4 (5)
Total	2913	1283.3	2123	1111.7
Average/net set	242.7	106.9	176.9	92.6

[a]Percentage of total catch for the year.

Burbot, yellow perch, and longnose suckers collectively comprised the remaining 4% of the total weight.

Relative abundance of species was virtually the same in both study years. Cisco, lake whitefish and common white suckers were the most frequently encountered species in the gill nets (Fig. 3). Burbot and longnose suckers were caught infrequently. In 1963-64, walleye comprised 7% of the gillnet catch and were more abundant than northern pike and yellow perch which were captured with equal frequency. In 1989, however, northern pike rumbers made up 7% of the total catch exceeding the contribution of either walleye or yellow perch. Walleye comprised only 5% of the total catch in 1989. Yellow perch comprised 3% of the catch in both years.

LAKE WHITEFISH

Numbers of lake whitefish caught in gill nets did not change significantly between 1963-64 and 1989. The length frequency distribution of fish caught in various mesh sizes of gillnet shows that in the current study, the 7.6 cm mesh size yielded the largest number of lake whitefish, with most being 32-34 cm in fork length (Fig. 4). In 1963-64, the 10.2 cm mesh size was the most efficient in catching lake whitefish and the majority of these fish were 36-40 cm in fork length. This difference in catch distribution reflects an increase in the number of small fish present in the lake in 1989.

Although the numbers of small fish increased, the size range within the population remained the same between years. The largest lake

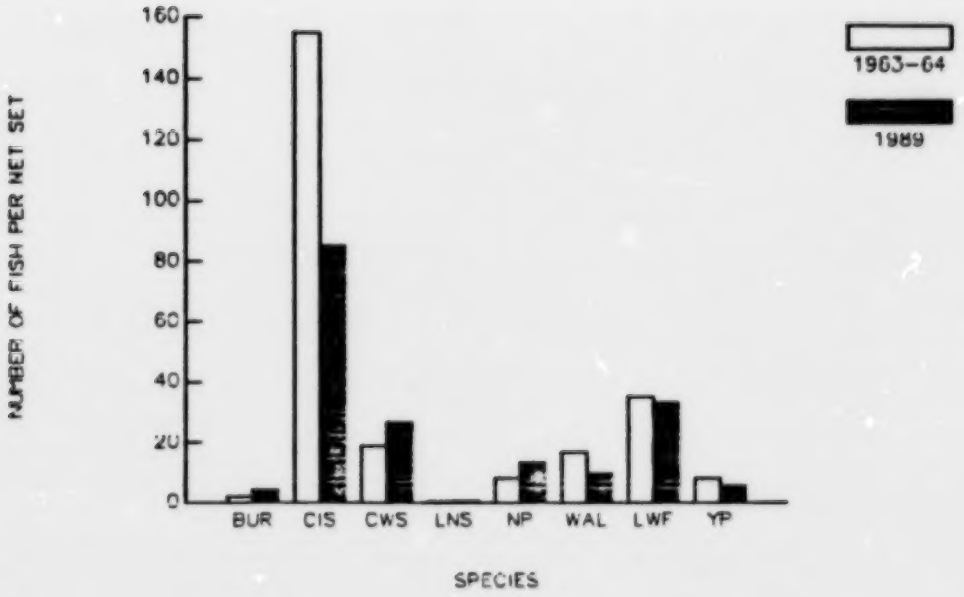

Fig. 3. Frequency distribution of fish species caught per gillnet set in Pelican Lake in 1989 and 1963-64.

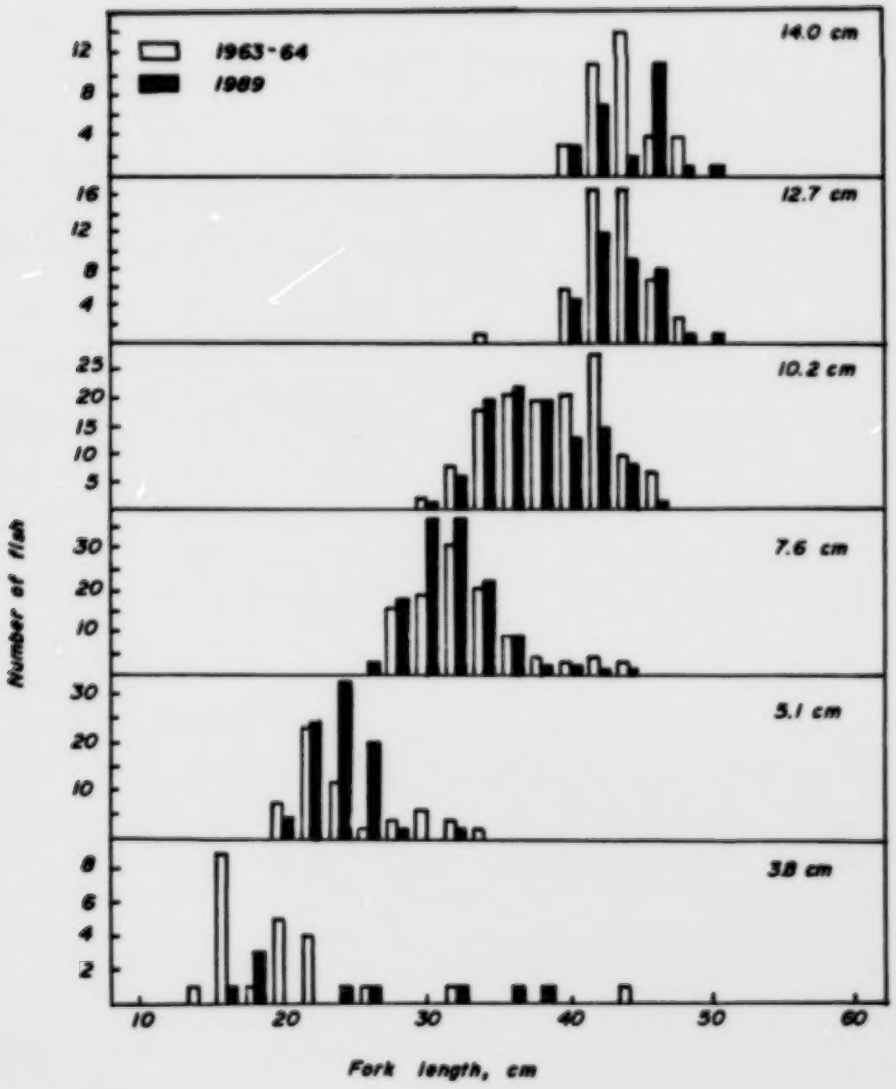

Fig. 4 Length frequency distribution of lake whitefish captured in various mesh sizes of gillnet in Pelican Lake in 1963-64 and 1989.

whitefish caught during the 1989 study, and the 1963-64 study had fork lengths of 48.8 cm and 48 cm, respectively (Table 3). However, the largest fish caught in 1989 was 114 g heavier than the largest fish caught in 1963-64. This is more likely indicative of variances between individual fish rather than a trend toward better condition, as overall, lake whitefish sampled in the earlier study were slightly heavier per unit length than were those collected in the current study (Fig. 5).

Modes in the length frequency distribution of those fish caught in 1963-64 occur at 16 cm, 22 cm, 32 cm, and 42 cm (Fig. 6) and represent age groups 1, 2, 4-5, and 7 years (Johnson, 1967). Modes in the distribution of lake whitefish landed in 1989 occur at 24 cm, 32 cm, 42 cm, and represent 4-5, 7 and 12 year olds.

In the earlier study, lake whitefish ages were determined using scales removed from a representative sample of the total lake whitefish catch. In 1989, ages were determined using scales and otoliths. A comparison of results obtained from these two media indicate that up to 6 years of age, scales and otoliths gave consistent results (Table 4). For fish 6 years of age and older, otolith ages were generally higher. Since the greater portion of the whitefish population sampled were younger than 6 years of age, either scales or otoliths could have been used for age determination. In this case, scales were used for fish in the 1-5 year age classes simply because they provided a larger sample size (many otoliths from these younger fish were broken). Otoliths were used to determine the age of those fish older than a scale age of 5 years. Since the number of fish aged was only a small sub

Table 3. Length weight data for five fish species caught in gill nets in Pelican Lake in 1963-64 and 1989.

Species		1963-64 Length (cm)	1963-64 Weight (g)	1989 Length (cm)	1989 Weight (g)
Cisco	Mean	26.3	303.5	27.7	279.3
	Max	39.4	1148	41.4	1025
	Min	5.6	28	7.6	35
Lake whitefish	Mean	34.1	691.7	32.5	537.6
	Max	48	1786	48.8	1900
	Min	12.3	34	15.7	27
Northern pike	Mean	54.4	1170.2	57.1	1516.1
	Max	73.2	2812	101	8800
	Min	34.5	295	23.2	90
Yellow perch	Mean	15.6	58.4	17.2	66.8
	Max	20.8	119	23.8	190
	Min	9.4	11	12.5	25
Walleye	Mean	33.4	477.3	34.8	494.9
	Max	47.5	1701	61.4	2000
	Min	10.4	14	17.3	50

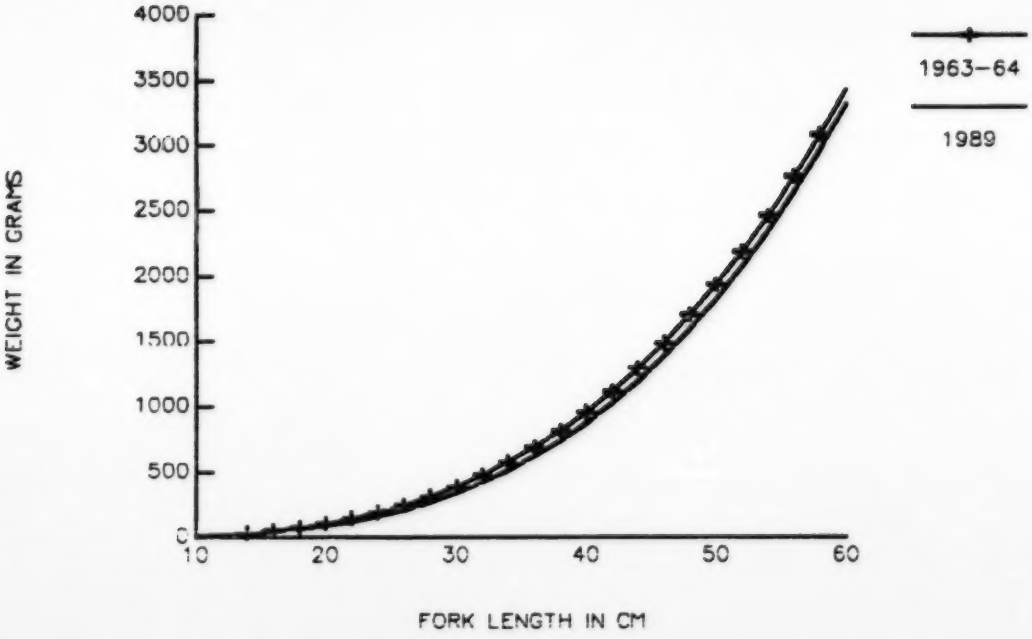

Fig. 5. Weight-length relationships of lake whitefish caught in 12 gillnet sets in Pelican Lake in 1989 (n=393) and 1963-64 (n=415). (1989: $W=0.008312*L^{3.16004}$; 1963-64: $W=0.004449*L^{3.304322}$).

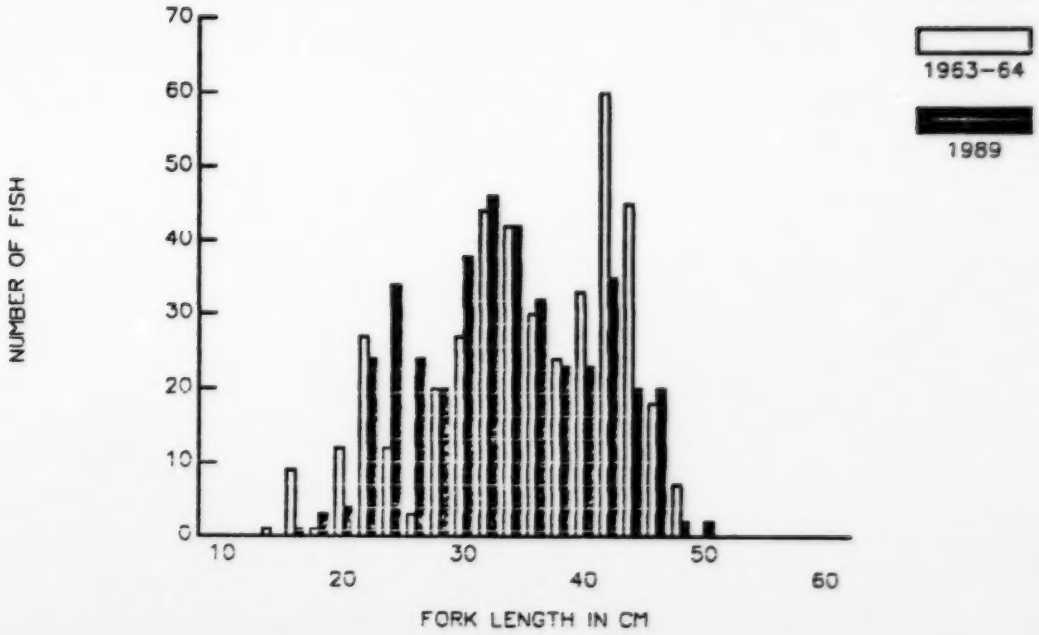

Fig. 6. Length frequency distribution of lake whitefish caught in 12 gillnet sets in Pelican Lake in 1989 (n=393) and 1963-64 (n=415).

Table 4. Comparison of ages determined from scales and otoliths collected from lake whitefish caught in 12 gillnet sets in Pelican Lake in 1989.

Scale age (y)	Mean otolith age (y)	Standard Deviation	Number otoliths
1	-	-	1
2	2.1	0.87	8
3	3.0	0	6
4	4.1	0.71	21
5	4.8	0.71	24
6	6.4	1.9	15
7	7.8	2.8	6
8	9.0	4.4	5
9	-	-	1
10	11	-	1
12	12	-	1

sample in both 1963-64 and 1989, a length age key was used to determine the age composition of the total sample in both years.

The age distribution and growth of lake whitefish is shown in Fig. 7. The distribution of ages in the present study was wider than that for the 1963-64 study and included age classes 10-13. A larger number of young fish were collected in 1989 than in 1963-64 but in both years, the greatest portion of the catch was in the 4-5 year age class. Growth rates were rapid in the first 3-4 years of life for both 1989 and 1963-64 fish. Older fish continued to grow at a reduced rate, which is particularly evident for those fish caught in 1989. Age at maturation was no later than 5 years for females and 4 years for males (Appendix 1). Fork length at maturation tended to be no greater than 32.5 cm.

No quantitative data on the diet of whitefish in Pelican Lake was acquired during the course of the study. A qualitative assessment showed that sphaeriid clams and midge larvae (Chironomidae) were the major food items of this species. Similar results were reported by Johnson (1967). Other food items included caddisflies, damselflies and other dipterans.

NORTHERN PIKE

The catchability of northern pike in gill nets is a reflection of the catchability of their prey species, as pike tend to be caught by their teeth in a net rather than actually be gilled. In both 1989 and 1963-64, over 60% of the total catch of pike was caught in the 5.1 cm and 7.6 cm mesh sizes, which coincidently yielded 83% and 64% of

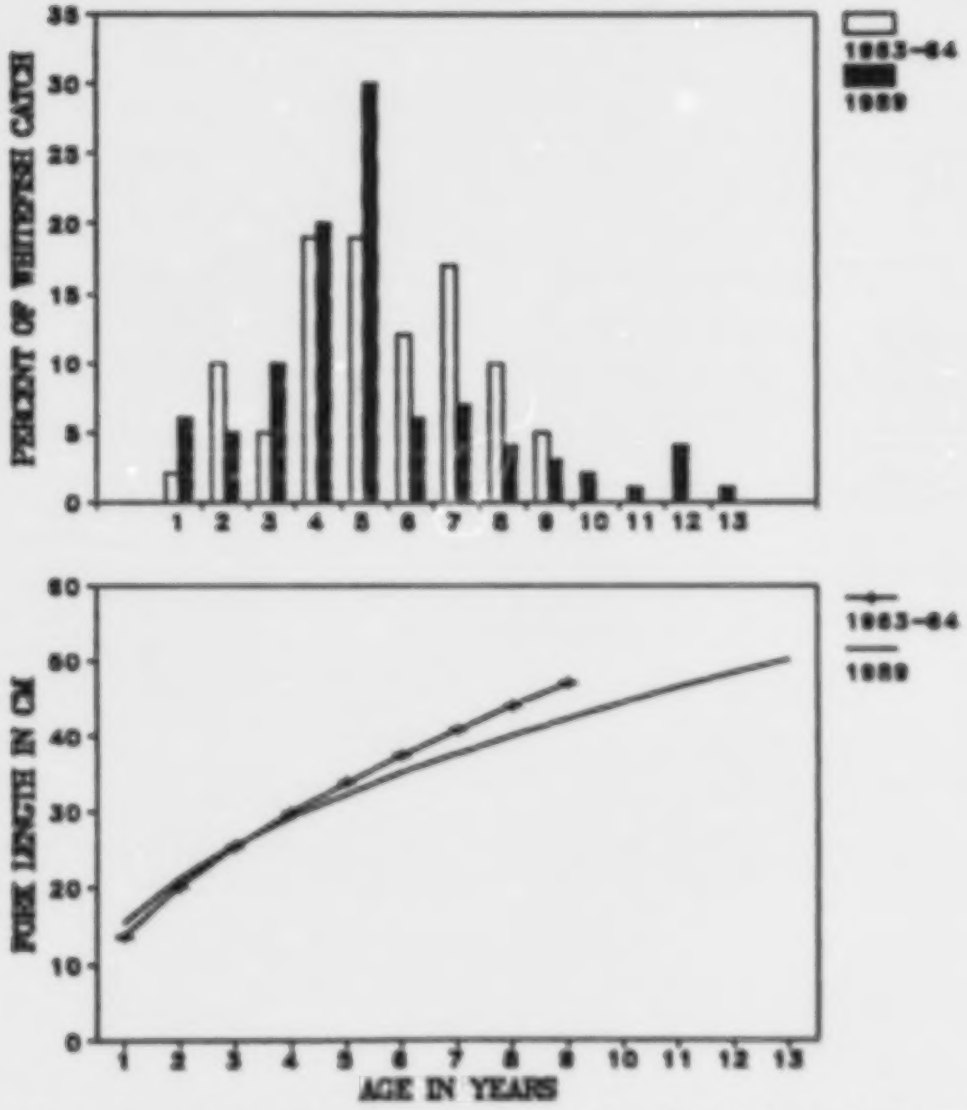

Fig. 7. Age distribution and growth of lake whitefish caught in 12 gillnet sets in Pelican Lake in 1989 and 1963-64.

the cisco in those years, respectively (Appendix 2). The two largest mesh sizes (12.7 cm and 14.0 cm) were virtually ineffective in catching this species. Further analysis of the net catch data revealed that a strong correlation existed between depth and numbers of pike caught in the nets ($r=0.69$; $p<0.05$), with over 70% of the catch from depths less than 10 m (Appendix 2).

The abundance of northern pike in Pelican Lake increased by 67% from 1963-64 to 1989 (Table 2). The length frequency distribution of the pike caught in gill nets showed a wider range of fork lengths in 1989 than in the earlier study (Fig. 8). In the 1963-64 study, lengths ranged from 34.5 cm to 73.2 cm with an average fork length of 54.4 cm (Table 3). Weights ranged from 295 g to 2812 g with an average of 1170.2 g. Fish caught in the current study ranged in size from 23.2 cm to 101 cm in fork length and weighed from 90 g to 8800 g. The average fish was 57.1 cm in fork length and weighed 1516.1 g.

These data suggest that pike caught in 1989 were larger than those observed in 1963-64. Analysis of length weight data collected from both years, however, indicated that pike taken in the earlier study tended to weigh more per unit length than did those collected in the present study (Fig. 9).

Modes in the distribution of the 1963-64 data occur at 36 cm, 44 cm, 52 cm and 56 cm representing a majority of 3 and 4 year olds (Johnson, 1967). Modes in the distribution of the 1989 data occur at 48 cm, 60 cm, and 70 cm and represent a majority of 3-5 year olds.

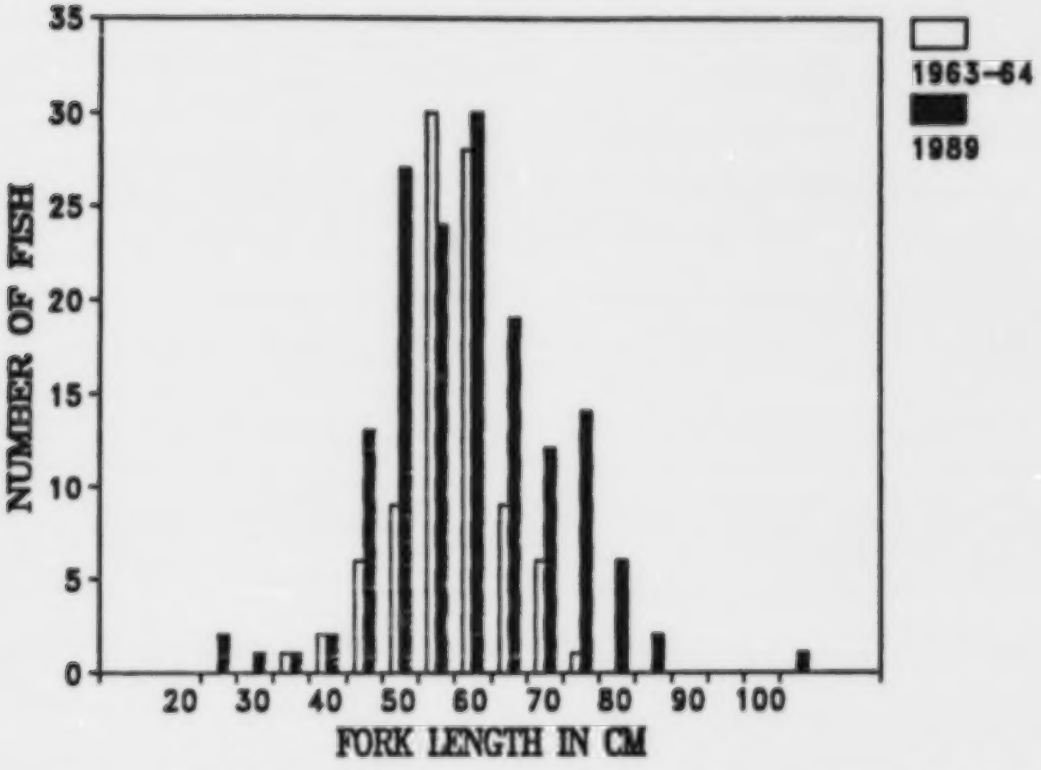

Fig. 8. Length frequency distributions of northern pike caught in 12 gillnet sets in Pelican Lake in 1989 (n=154) and 1963-64 (n=92).

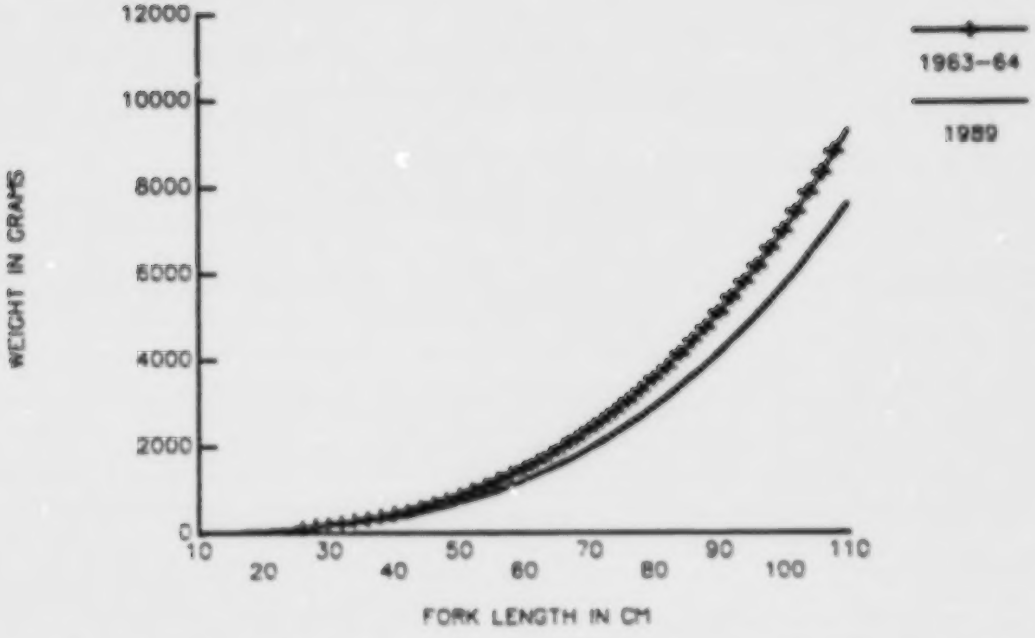

Fig. 9. Weight-length relationships of northern pike caught in 12 gillnet sets in Pelican Lake in 1989 (n=154) and 1963-64 (n=92). (1989:W=0.005034*L3.027414; 1963-64: W=0.006273*L3.02343)

In 1963-64, ages for pike were estimated from scales from 46 samples. A length/age key was used to extrapolate these data to include the total sample. In 1989, both scales and cleithra were used and gave similar results (Table 5). Although either scales or cleithra could have been used in age determination of northern pike from Pelican Lake in 1989, more cleithra were collected providing a larger sample size (n=145).

Age distribution and growth of northern pike in 1989 and 1963-64 are shown in Fig. 10. The age distribution of fish caught in 1989 ranged from 1-11 years, with the majority (59%) of fish 5 years of age or older. The 1963-64 fish were between 2 and 7 years of age with the greatest portion (52%) of the catch comprised of 3 year olds. The growth rate of pike in 1989 was rapid in the first 2 years. Fish older than 2 years were sexually mature (Appendix 3) and continued to grow at a reduced rate. Fish collected in 1963 64 exhibited a fast growth rate in all age classes. A comparison of the two growth rates showed that up to 4 years of age, fish caught in 1989 were longer at age than their 1963-64 counterparts. After 4 years of age, however, pike caught in 1989, were smaller than their 1963-64 equivalent.

The diet of northern pike from Pelican Lake was characteristic of this species from other lakes. Fish, primarily perch, comprised 83% of their diet in 1963-64 (Johnson, 1967). While only 30% of the stomachs sampled in 1989 contained food remains, these remains covered a wide variety of fish species, including ciscoes, perch, shiners, suckers, sticklebacks and walleye.

Table 5. Comparison of ages determined from scales and cleithra collected from northern pike caught in gill nets in Pelican Lake in 1989.

Scale age (y)	Mean cleithrum age (y)	Standard Deviation	Number cleithra
1	1	0	1
2	2.0	0	10
3	2.9	0.25	14
4	4.0	0.35	35
5	5.2	0.51	31
6	6.2	0.78	24
7	7.8	0.68	12
8	9.5	1.11	8
9	11.0	0	1
10	11.0	0	1

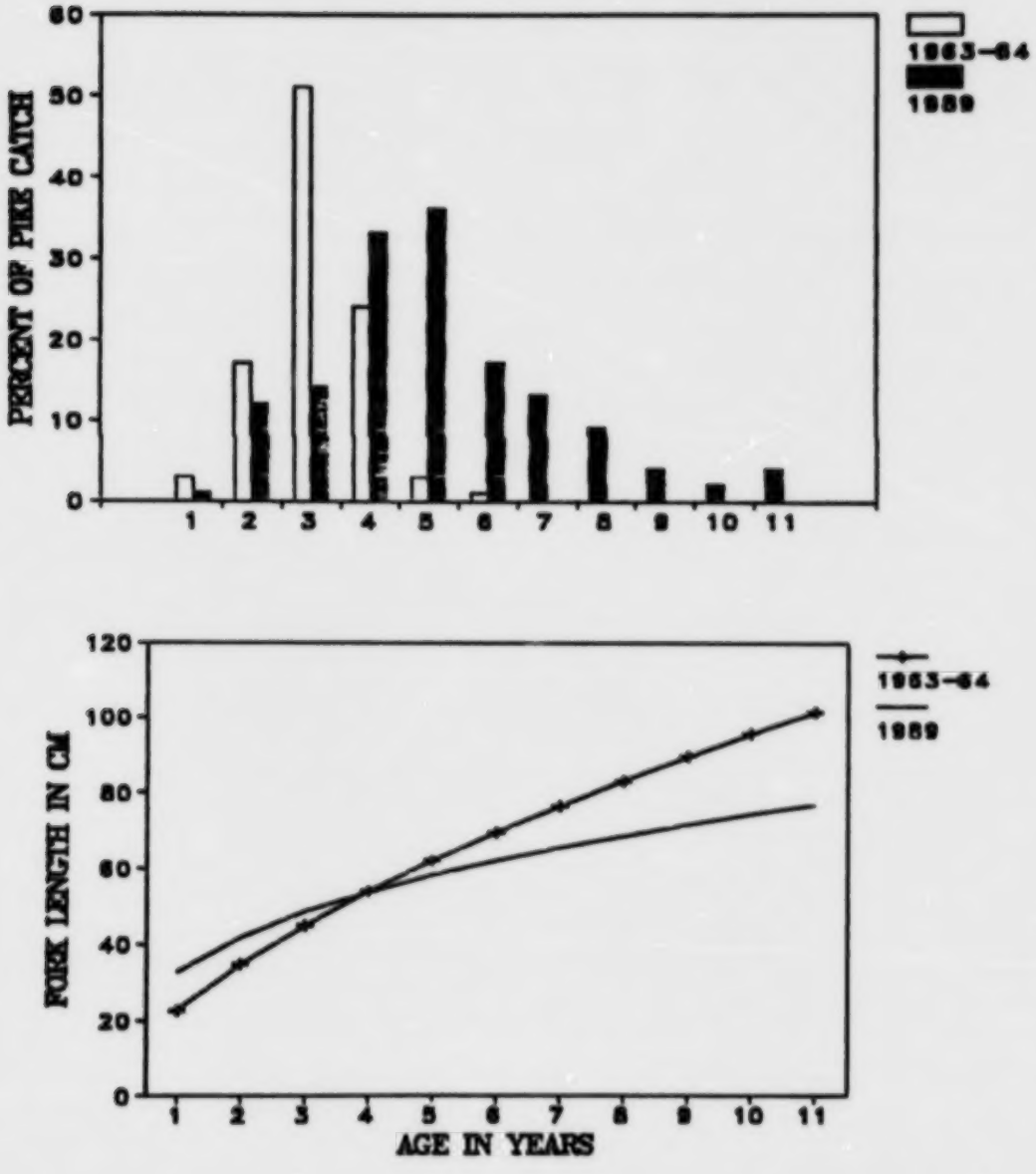

Fig. 10. Age distribution and growth of northern pike caught in 12 gillnet sets in Pelican Lake in 1989 (n=145) and 1963-64.

WALLEYE

The number of walleye caught in gill nets in 1989 were significantly correlated with depth ($r=0.63$; $p<0.05$). The majority of fish were caught in water less than 10 m in depth (Appendix 2). A few walleye were caught in the 3.8 cm and 10 cm mesh sizes of gillnet, but the majority were taken in the 5.1 cm and 7.6 cm mesh sizes in both 1963-64 and 1989 (Appendix 2). The larger mesh sizes of 10.1 cm, 12.7 cm and 14.0 cm were not effective in catching walleye in Pelican Lake.

The length frequency distributions of walleye caught in 1989 showed a shift to the right of the scale when compared to those caught in Pelican Lake in 1963-64 (Fig. 11) indicating an increase in the size of fish between years. In 1989, the size of walleye ranged from 17.3 cm to 61.4 cm in fork length with an average of 34.8 cm. An average weight was approximately 495 g ranging from 50-2000 g. The largest walleye landed in 1963-64 had a fork length of 47.5 cm and weighed 1701 g (Table 3). The average fish from that study had a fork length of 33.4 cm and weighed 477 g.

Curves illustrating the weight to length relationships of walleye removed from Pelican Lake in 1963-64 and 1989 were similar (Fig. 12), suggesting no change in growing conditions between years.

Walleye ages were determined using scales in both 1989 and 1963 -64. Otoliths were also collected in the current study, but many were rendered useless due to breakage.

Age composition and growth of walleye are shown in Fig. 13. In the current study, 99 fish were aged. Ages ranged from 1-8 years

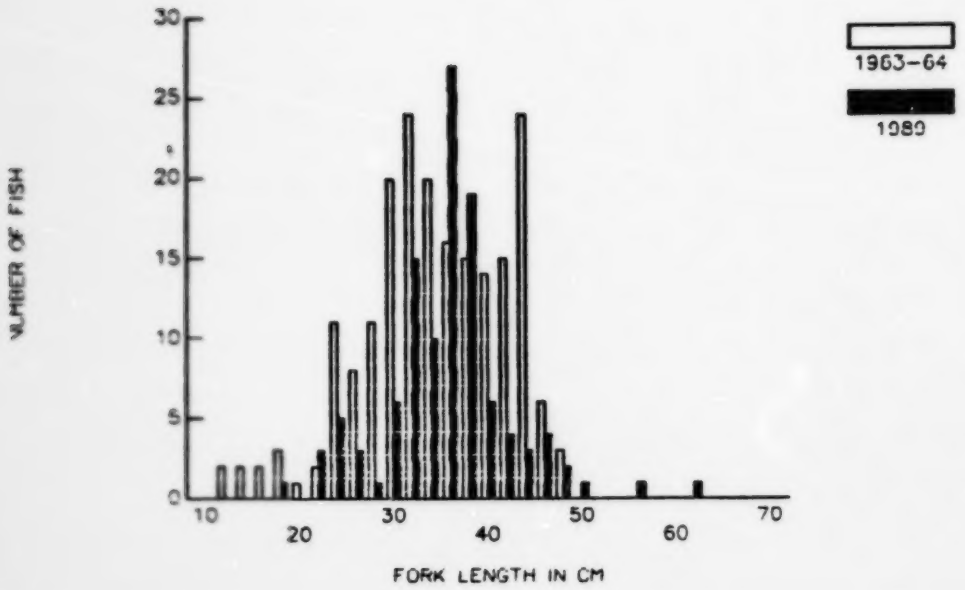

Fig. 11. Length frequency distributions of walleye caught in 12 gillnet sets in Pelican Lake in 1989 (n=112) and 1963-64 (n=199).

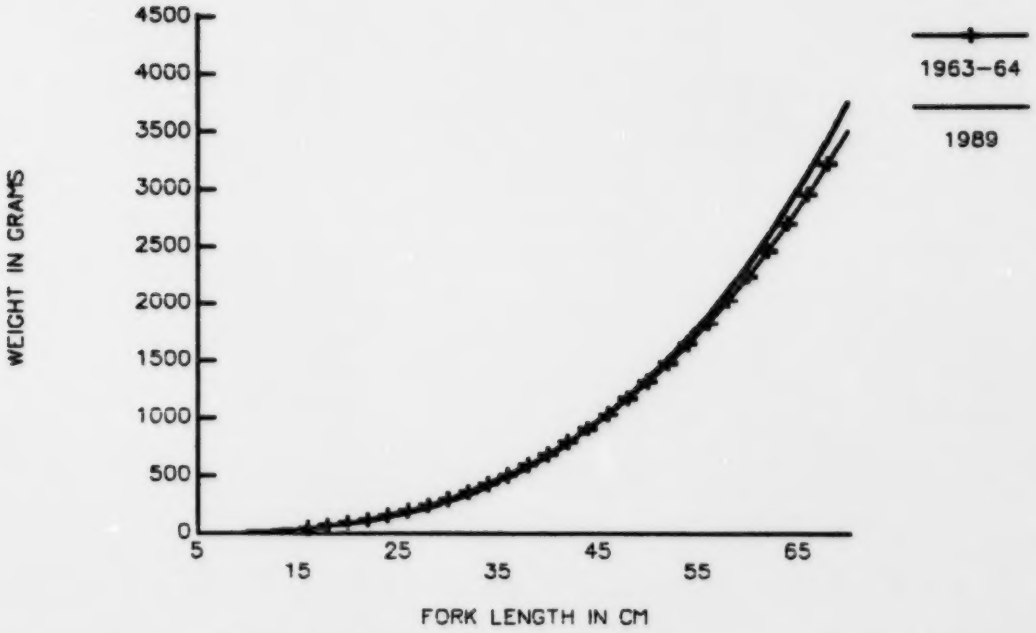

Fig. 12. Weight-length relationships of walleye caught in 12 gillnet sets in Pelican Lake in 1989 (n=112) and 1963-64 (n=199). (1989: $W=0.008317*L^{3.065468}$; 1963-64: $W=0.014774*L^{2.9143}$)

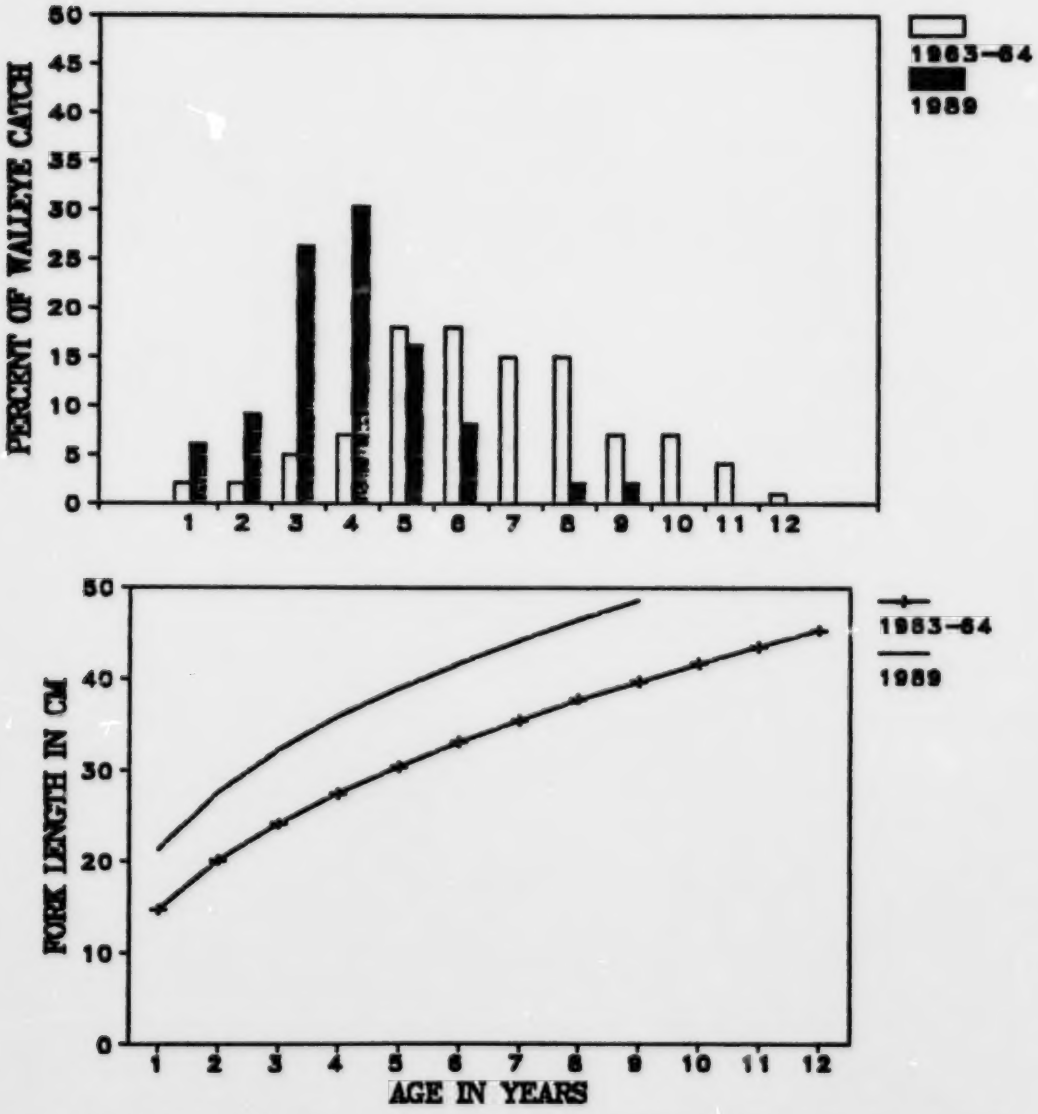

Fig. 13. Age distribution and growth of walleye caught in 12 gillnet sets in Pelican Lake in 1989 (n=99) and 1963-64.

with 96% of the catch no older than 6 years. No fish from the 7 year age class were caught. The majority (57%) of fish sampled were in the 3 and 4 year age classes. In 1963-64, 70 fish were aged and extrapolations were made using a length-age key. Estimates ranged from 1-12 years of age with the largest portion of the catchable population falling into the 5 and 6 year age classes.

The growth curve for the current population of walleye indicates a period of very rapid growth in the first year of life. Fish one year and older displayed a rate of growth comparable to that shown by the 1963-64 population. At any given age, walleye taken in 1989 had a longer fork length at age than did the 1963-64 fish, the result being that fish now take 2-3 years less time to reach a catchable size than in 1963-64. All fish younger than 4 years of age were sexually immature and only 11% of the 4 year olds were mature (Appendix 4). The data suggest that within this population, sexual maturity is achieved between 4-5 years for males and between 5-6 years for females.

A qualitative examination of walleye stomachs in 1989, revealed the majority of stomachs were empty. In those stomachs containing food remains, fish (perch and sticklebacks) and insects (caddisflies and dragonflies) were the primary constituents. In 1963-64, over 70% of food items selected by walleye were fish (Johnson, 1967).

CISCO

Numbers of cisco caught in gill nets showed a decrease between study years. There was a greater number of larger fish caught in 1989, but these fish were not as robust as their 1963-64 counterparts. In the earlier study, mean fork length was 26.3 cm with a mean weight of 304.4 g (Table 3). In 1989, the average fish had a fork length of 27.7 cm and weighed 279.3 g. The largest cisco captured in 1963-64 was 39.4 cm in length and weighed 1148 g. In the later study, 41.4 cm was the largest recorded fork length coincident with a weight of only 1025 g.

Aging media were not collected from ciscoes in 1989. Although ciscoes are important as a forage fish, they are not considered a recreationally or economically important species. Aging data from the earlier study were unavailable.

Many of the cisco stomachs sampled in 1989 were empty. Of those that did contain foodstuffs, plankton was the major dietary food item. Quantitative analysis of food items selected by ciscoes in Pelican Lake in 1963-64 revealed that plankton formed 85% of this species diet (Johnson, 1967).

YELLOW PERCH

The total number of yellow perch caught in gill nets in Pelican Lake was approximately 32% less than the number taken in the earlier study, however, relative abundance remained the same (Table 2). In 1989, the number of fish caught in nets was significantly correlated

with water depth ($r=0.62$; $p<0.05$); over 60% of the total catch was obtained in depths less than 10 m (Appendix 2).

The susceptibility of yellow perch in Pelican Lake to gill nets appears to be restricted to the 3.8 cm mesh and the 5.1 cm mesh sizes; in both years, over 66% of the total perch catch was obtained in the 3.8 cm mesh. Larger mesh sizes were not effective in catching perch in either year.

In 1963-64, fork length ranged from 9.4 cm to 20.8 cm with a mean length of 15.6 cm (Table 3). The heaviest perch weighed 119 g and the lightest was only 11 g. On average, perch captured in Pelican Lake in 1963-64 weighed 58.4 g. Fish caught in gill nets in 1989 ranged in size from 12.5 cm to 23.8 cm in fork length with an average of 17.2 cm. Weights were between 5 and 190 g with a mean of 67 g.

Yellow perch of the size found in Pelican Lake are not currently considered a recreationally or economically important species. Therefore, aging media were not collected in 1989.

UTILIZATION OF THE FISH RESOURCE

Commercial fishing on Pelican Lake began in 1948. At that time a quota of 22 700 kg was established. Species included were lake whitefish, walleye, northern pike, and lake trout. In 1951, the quota increased to 34 050 kg but returned to 22 700 kg in 1952. The allowable catch was increased to 31 780 kg in 1963 and again in 1966 to 36 320 kg. A 10% gamefish tolerance limit restricting the number of game fish permitted was adopted in 1969 to protect the commercial fishery against

criticism from the expanding sport fishery. The current quota of 45 400 kg with a 10% allowance of walleye, pike and trout was established in 1970. The legal mesh size of 11.4 cm has remained unchanged since 1948.

The number of commercial licenses issued since 1948 has varied from 2 to 34 per annum and total fish production has ranged from a low of 589 kg (0.05 $kg \cdot ha^{-1}$) in 1986 to a high of 54 023 kg (5.35 $kg \cdot ha^{-1}$) in 1968 (Appendix 5). An average of 2.42 $kg \cdot ha^{-1}$ was harvested annually over the last 40 years, and was comprised of 86.9% whitefish, 6.7% walleye, 6.2% pike, and 0.1% trout. Other fish species comprised less than 0.1% of the annual harvest.

In 1989, 13 commercial licenses were issued and total production yielded 29 033 kg (2.9 $kg \cdot ha^{-1}$). Lake whitefish comprised 97% of the total harvest with walleye and pike making up the remaining 3%. Lake whitefish have formed over 60% of the total commercial production since 1948, with the exception of 1949, 1950, and 1953, and over 90% of the harvest since 1976. Walleye and northern pike production is minimal and reporting of lake trout virtually ceased after 1966.

Average commercial production for each decade since 1948 is shown in Table 6. Production peaked between 1960 and 1969 with an average yield of 39 790 $kg \cdot yr^{-1}$. Although the number of licenses issued increased in the 1970s, the harvest decreased to an average of 28 060 $kg \cdot yr^{-1}$. The total harvest continued to decline through the 1980's, being consistently and substantially less than the 45 400 kg allowable catch.

Table 6. Average commercial fish production (kg x 10^3) in Pelican Lake in each decade since 1948.

	Whitefish	Walleye	Trout	Pike	Other	Total	Total No. Licenses
1948-49	0.7	0.1	0.02	-	-	0.7	2
1950-59	7.0	1.6	0.09	0.5	-	9.3	86
1960-69	32.1	3.3	0.04	4.2	-	39.7	200
1970-79	26.0	1.1	-	0.9	-	28.0	243
1980-89	19.0	0.4	-	0.4	0.03	19.8	135

Estimates of total Indian fish harvests for 1984-1989 are shown in Appendix 6. The values were obtained from official records which are believed to underestimate the native harvest by a factor of 10 (Murray and Clouthier, 1986). Within the described 5 year period, it was estimated the fishery annually may have harvested 30 600 kg or 3.0 $kg \cdot ha^{-1}$: 65% whitefish, 4% walleye, 5% northern pike, and 26% rough fish (ciscoes, burbot, suckers). The commercial fishery, for the same time period, produced 17 850 kg or 1.75 $kg \cdot ha^{-1}$ on an annual basis, comprised of 96% whitefish, 2% walleye, and 2% northern pike.

Potential harvest by the sport fishery in 1987-88 was estimated at 36 720 kg (3.6 $kg \cdot ha^{-1}$) comprised of 44% walleye and 56% northern pike (Walton, 1988). These values represent a minimum of the potential recreational yield, and were calculated using the following information obtained from the outfitters:

Total number of (outfitter) beds - 135

Occupancy rate - 35%

Length of stay -3 days

Length of season -180 days

Average size of fish - walleye: 1.0 kg
pike: 1.2 kg

Between 1984 and 1989, estimated total yearly harvest of the Pelican Lake fishery by all user groups was 85 170 kg, or 8.35 $kg \cdot ha^{-1}$ (Table 7). The recreational fishery harvested approximately 43% of this total, with the Indian and commercial fisheries making up 35% and 21%, respectively.

Table 7. Estimated average annual user harvest (kg) of fish from Pelican Lake from 1984 to 1989.

User	Lake Whitefish	Walleye	Northern Pike	Other	Total
Commercial	17 136	408	306	-	17 850
Indian	19 380	1020	2040	8160	30 600
Angler*	-	16 320	20 400	-	36 720
Total	36 516	17 748	22 746	8160	85 170

*Minimum potential angler harvest as estimated by Walton (1988) for Pelican Lake.

5. DISCUSSION

FISH POPULATIONS

Eight species of fish were caught in gill nets in Pelican Lake both in 1989 and 1963-64. Johnson (1967) reported that lake trout were also present in the lake in 1963-64. However, they were rare and none were taken in the nets. Numbers of fish collected per net set decreased slightly since the earlier survey, but total gamefish (i.e. walleye and northern pike) abundance has remained virtually unchanged. Compared to other Saskatchewan water bodies, such as Montreal Lake (90 game fish/net; Merkowsky and Sawchyn, 1988), Tobin Lake (70.6 game fish/net; Durbin, 1981), and Jackfish Lake (47.3 game fish/net; Durbin 1980), Pelican Lake (22.2 game fish/net) is low in gamefish abundance. It should be noted that 8 of the 12 test nets (67%) were set in water greater than 10 m deep; depth zones which account for 45.7% of the surface area of Pelican Lake. Depths less than 10 m account for 54.3% of the lake's surface area but were sampled by only 4 test nets. Results show that greatest numbers of pike and walleye were caught in the shallower depth zone suggesting the abundance of these fish may have been underestimated. Weighting the test net data to account for this, however, did not significantly change the results:

Species	No./net set	Weighted No./net set
Walleye	9	14
Pike	13	17
Whitefish	32.7	28.3

Lake whitefish was the most abundant of the three economically significant species in Pelican Lake in 1989. Compared to other lakes in the province, the average catch of whitefish per net set represents a high abundance of this species:

Water body	No. of Whitefish/set	Source
Pelican L.	32.7	present study
Pinehouse L.	17.2	Liaw 1988
Dore L.	15.2	Sawchyn 1987
Delaronde L.	9.9	Liaw 1976
Montreal L.	9.0	Merkowsky and Sawchyn 1988

Abundance of whitefish in Pelican Lake in 1989 was similar to what it was in 1963-64, but there was a greater number of older fish observed in the present study. This latter observation may simply be the result of using otoliths as an aging tool for older fish, as studies have revealed that otolith growth shows a higher portion of older fish in a population than would be expected using the scale method of age determination (Beamish and Chilton, 1982). The lack of 1+ whitefish in the Pelican Lake population reflects mesh size and possibly net placement rather than poor reproductive success in the year preceding the study. Due to their small size, young whitefish are often difficult

to catch in a gill net. The presence of older specimens suggests that exploitation of this species was low in the years preceding the study.

The marketability of lake whitefish depends highly upon the rate of infestation of cysts of the tapeworm *Triaenophorus crassus*. Fish with infestation levels exceeding 80 cysts per 45 kg are classified as "C", or cutter fish and cannot be marketed for human consumption within Canada without the removal of the cysts. Levels exceeding a 40 cysts per 45 kg tolerance limit cannot be exported. Prior to 1948, commercial fishing was prohibited on Pelican Lake due to an excessive infestation of *T. crassus* cysts. In 1947, infestation rates were found to be well below the Canadian tolerance levels, and in 1965, they were well below levels acceptable for export (Johnson, 1967). In 1985, however, lake whitefish were once again classified as "C" fish, and this is reflected in the greatly reduced commercial harvest in 1986- 88 (Appendix 5). The "cutter" classification currently stands. The increase in abundance of older fish in the population is probably the result of a reduced harvest caused by high cyst infestations.

Lake whitefish in Pelican Lake grow more slowly than whitefish in Montreal Lake (Merkowsky and Sawchyn, 1988) and Pinehouse Lake (Liaw, 1988) but at a rate comparable to the whitefish population in Dore Lake (Sawchyn, 1987)). Fish older than 5 years of age displayed a slower pattern of growth when compared to fish from the earlier study, suggesting sexual maturity is attained at or around 5 years of age in this population. The whitefish sampled from 1989 tended to weigh slightly less per unit of length than the 1963-64 fish but this

difference is probably too small to have an effect on the growth rate. The presence of numerous older and larger fish in the 1989 population is more likely responsible for the observed depressed growth rate, as these fish would consume larger quantities of food at the expense of younger smaller fish but with less resultant growth.

Northern pike was the more abundant of the two resident gamefish species in Pelican Lake, but numbers caught per net set indicate low abundance when compared to other lakes in the province:

Waterbody	No. of pike/net set	Source
Montreal L.	40	Merkowsky and Sawchyn 1988
Pinehouse L.	23	Liaw 1988
Guilloux L.	19	Liaw 1986
Pelican L.	13	present study
Dore L.	6	Sawchyn 1987

Unlike the earlier study, wherein the pike population was represented by young age classes, the 1989 population was characterized by an increase in the number of older fish. While such differences in the age structure of a fish population can often be attributed to using different media (i.e. calcified tissue versus scales) for age determination (Weatherley and Gill, 1987), age estimates made from scales and cleithra collected in 1989, were very close. Similar to the whitefish population, few one year old fish were taken in the gillnet catches. Young pike tend to be found in shallow, inshore areas where food is abundant, emergent vegetation provides cover, and the risk of predation is minimized. The presence of numerous older fish, suggests healthy recruitment in the past.

The growth rate of the current pike population in Pelican Lake is slower than observed in 1963-64, but comparable to growth rates observed for the same species in Montreal Lake (Merkowsky and Sawchyn, 1988), Pinehouse Lake (Liaw 1988), Dore Lake (Sawchyn, 1987), and Jackfish Lake (Durbin 1980). Northern pike over 45 cm in fork length (approximately 4 years of age) were heavier for any given length in 1963-64, suggesting the slower growth rate is a result of increased numbers, particularly with regard to older and larger fish, and increased competition for a dwindling food supply: ciscoes, a known forage species of pike, showed a significant decrease in abundance between study years.

Walleye was the least abundant economically important species in Pelican Lake in 1989. Compared to other lakes in the province, Pelican Lake does not have an abundant walleye population:

Waterbody	No. of pike/net set	Source
Montreal L.	50	Merkowsky and Sawchyn 1988
Pinehouse L.	48	Liaw 1988
Guilloux L.	45	Liaw 1986
Pelican L.	9	present study
Dore L.	1	Sawchyn 1987

The growth of the current population is slow when compared to the heavily over exploited population of Dore Lake (Sawchyn, 1987), but is faster than the growth rate observed for the more lightly fished population from Montreal Lake (Merkowsky and Sawchyn, 1988). Johnson (1967) reported walleye in Pelican Lake were in danger of being over exploited in the years following his study if management restrictions were not placed on the harvest. The age structure of the current

population (i.e. large, young fish) and the rapid rate of growth and age at maturity exhibited by the walleye population suggest that these fish are subjected to extremely heavy fishing pressure. While the majority of walleye vulnerable to the commercial fishing nets are mature and probably spawn at least once before being harvested, the portion of the population taken by anglers is unknown.

The health of a population of forage fish can be an index to the health of resident gamefish populations. Ciscoes and yellow perch, while not economically significant in Pelican Lake, are important forage species. Length and weight data for these species were analysed to complete the comparison of fish species investigated in the 1963-64 study.

Ciscoes were significantly less numerous in Pelican Lake in 1989. The population was made up of fish that were longer but less robust than those sampled in the earlier study, suggesting that food availability may be a restricting factor on this population. Johnson (1967) reported that age determination of ciscoes in Pelican Lake revealed abnormal variations in growth and suggested the presence of more than one species. In the current study, small mature fish and large immature fish were often observed, lending support to Johnson's conclusion.

Seining data collected from Pelican and other lakes in 1963-64 (Johnson, 1967) suggests that gillnets do not provide an adequate method of obtaining a representative sample of the yellow perch population in some lakes. Johnson (1967) found that yellow perch made

up over one half of the 4900 fish collected by seining the littoral zone of Pelican Lake in 1963-64 and over 80% of the 2000 fish similarly collected in Jan Lake in the same year. No seining was done in the current study.

LAKE PRODUCTIVITY

The determination of potential fish yield within a lake is necessary for the successful management of the utilization of the resource. In the past, the most highly recognized estimator of potential fish yield has been the morphoedaphic index (Ryder et al., 1974). This index (MEI) was originally described as a general method of calculating fish yields from north-temperate lakes and is defined as the ratio of total dissolved solids (TDS) and mean depth (z) (Ryder, 1965). Other models, incorporating factors more closely related to fish productivity in a functional sense, have recently been developed. Two of these include macro benthos biomass (wet weight) in relation to mean depth (Hanson and Leggett, 1965) and the standing crop of bottom fauna (dry weight) (Matuszek, 1978). Estimates of potential maximum sustainable yield (MSY) from Pelican Lake were calculated from the three models shown below using data obtained from Johnson (1967):

Model[1]	MSY $kg \cdot ha^{-1} \cdot yr^{-1}$	$kg \cdot yr^{-1}$
Total, Y=0.966 MEI (Ryder, 1965)	2.91	29 391
Total, $0.007M+0.018TDS-0.053z$ $+0.00007A_o + 0.793$ (r^2=0.66 Hanson and Leggett, 1982)	3.18	32 436
Total, $C_t/A=-0.5524+4.9307 \log BFWT$ (r^2= 0.828, Matuszek, 1978)	5.62	56 762

[1] MEI=morphoedaphic index, TDS/z; M=wet weight of bottom fauna, 149.0 $kg \cdot ha^{-1}$; TDS=total dissolved solids, 105 mg/L; z=mean depth, 11.6 m; A_o=water area, 100.21 km^2; C_t/A, y=total sustainable yield; BFWT=dry weight of bottom fauna, 17.9 $kg \cdot ha^{-1}$.

A comparison of the potential yields reveals that all three methods gave similar estimates. However, the predictive power of the MEI has come into question in the last few years. Matuszek (1978) reported that macro benthos standing crop was a much stronger index of fish productivity, accounting for up to 82.8% of the variability in the total fish yield, while the model proposed by Hanson and Leggett (1982) using macro benthos biomass explained 66% of the variation in the total fish yield.

Because it incorporates biotic elements (benthic organisms), explains the greatest amount of the variation in total fish yield, and gave the highest yield, the model proposed by Matuszek (1978) was accepted as the best indicator of potential fish yield. Thus, the potential maximum sustainable yield for all fish species from Pelican Lake was 5.62 $kg \cdot ha^{-1} \cdot yr^{-1}$ or 56 762 $kg \cdot yr^{-1}$. This is comparable to estimates of maximum sustainable yield for other lakes in the region (Liaw, 1986).

Sustained yields of highly valued species (walleye, whitefish, and pike) are given below and were determined from MSY using the percent composition by weight in the total gillnet catch (from Table 2):

Species	% catch by wgt.	Est. yield $kg \cdot ha^{-1} \cdot yr^{-1}$	Est yield $kg \cdot yr^{-1}$
Walleye	5.0	0.28	2828
Pike	21.0	1.18	11918
Whitefish	19.0	1.07	10807
Total	45.0	2.53	25553
Total highly valued species, $\log C_s/A = -0.169 + 0.562 \log BFWT$[1] ($r^2$ =.803, Matuszek, 1978)		3.42	34542

[1] C_s/a=sustainable yield of highly valued species; BFWT=dry weight of bottom fauna, 17.9 $kg \cdot ha^{-1}$.

The estimated total yield of walleye, pike and whitefish was slightly smaller than that suggested by Matuszek's (1978) equation. His highly valued species included lake trout, walleye, whitefish, and sauger, whereas only walleye, whitefish, and pike fall into this category in the present study. This difference in species composition may explain the observed difference in yield. The estimated yield for whitefish in Pelican Lake was similar to a range of estimated yields from other lakes in the same geographic region (from Liaw, 1986); the yield for pike was higher. The estimate for walleye compared only to that found in Guilloux Lake:

Lake	Maximum sustainable yield, $kg \cdot ha^{-1} \cdot yr^{-1}$		
	Walleye	Pike	Whitefish
Pelican	0.28	1.18	1.07
Guilloux	0.24-0.92	0.19-0.63	0.58-0.92
Pikoo	0.72-.079	0.60-0.66	0.88-1.37
Reeds	0.50-0.85	0.41-0.70	0.75-1.10
Sokatisewin	0.36-0.70	0.29-0.58	0.66-0.94

MANAGEMENT IMPLICATIONS

A comparison of total annual harvest records for the last 5 years (85 170 kg or 8.35 $kg \cdot ha^{-1}$) and the estimates of total potential sustainable yield of all species (5.62 $kg \cdot ha^{-1} \cdot yr^{-1}$) suggests that, in recent years, Pelican Lake has been providing a level of production well above the estimated sustained yield. Lake whitefish are being harvested at a rate almost three times the MSY for this species. The data suggests immature fish are not being taken in the commercial nets, and while it is not known what portion of the population is taken by the annual native harvest, the structure of the whitefish population is indicative of an underfished situation: an abundance of all year classes with few fish attaining a large size (Bennett, 1971). It can be concluded, therefore, that the calculated MSY for whitefish in Pelican Lake does not truly reflect a level of harvest the population can withstand. Until such time that whitefish receive a better commercial classification, making their harvest a more economically viable venture, the population will remain in its stunted state.

The MSY for northern pike was estimated at approximately 12 000 kg. Harvest records show this species is harvested at an annual rate of 22 750 kg, 90% of which is taken by the recreational fishery. The population is characterized by an abundance of year classes, wherein growth is rapid and large average sizes are attained. According to Bennett (1971) this population structure is indicative of sustainable harvest levels. Subsequently, a more realistic estimate of the MSY for northern pike in Pelican Lake is closer to 23 000 kg.

Based on the MSY for walleye (2800 kg), and the estimated annual harvest (17 750 kg; 92% landed by recreational fishermen), this species is being severely overfished in Pelican Lake. Population data obtained through testnetting support this. There is an abundance of young, immature fish not large enough to be of interest to anglers, while older and larger fish are virtually absent from the population. The point at which many fish reach a desirable size for anglers, is also the point at which many reach maturity. It is highly probable that many walleye in Pelican Lake are harvested before they have a chance to spawn, presenting a serious risk of a collapse in the population. Recovery may depend upon a reduction in the daily catch augmented by a spring closure to angling in known spawning areas such as Medicine Rapids, Chachukew Rapids, or Opawikusehikan Narrows.

Closure of spawning areas has proven to be an effective management tool in Puskwakau River, Twin Falls, Potatoe River, Otter Lake and other northern waterbodies. To avoid conflict between anglers

and commercial fishermen, commercial nets can be restricted to depths greater than 10 m.

6. SUMMARY AND CONCLUSIONS

1. A fishing survey was undertaken in Pelican Lake to evaluate the status of the resource, compare the results to those found in an earlier study conducted in 1963-64, and use the resulting information in future management decisions.
2. Pelican Lake is situated in northeastern Saskatchewan about midway between La Ronge and Flin Flon. The lake lies near the southern edge of the Precambrian Shield and covers an area of approximately 10,200 hectares. Average water depth is 11.6 m with a maximum depth of 32 m.
3. The small community of Pelican Narrows and 5 outfitters currently rely upon the fishery resource in the lake.
4. Eight species of fish caught in gill nets were the same as those caught in an earlier study.
5. Twelve standard gangs of gillnet yielded an average of 176.9 fish per net set in 1989 compared to the 242.7 in 1963-64.
6. Ciscoes were the most abundant species in the gillnet catches, followed by lake whitefish and common white sucker. These 3 fish species collectively comprised 81% of the total catch.
7. Numbers of northern pike, walleye, whitefish, common white sucker, longnose sucker, burbot, and yellow perch were not significantly

different between years. The cisco population showed a significant decline when compared to 1963-64 population.

8. The majority of lake whitefish caught were over 30 cm in fork length and weighed more than 0.5 kg. Over 50% of the specimens aged were 4-5 years of age. The growth rate of lake whitefish was slower in 1989 than in 1963-64 and fish over 4 years of age were consistently smaller at any given length. This is probably due to reduced fishing pressure which has resulted in the presence of a larger number of older fish in the population. Sexual maturity occurred at 5 years of age. Insect larvae were the major dietary item of whitefish.

9. Northern pike was the most abundant gamefish species. Sizes ranged from 23 cm to 101 cm but the majority were between 50-65 cm in length and weighed over 1 kg. In 1989, 41% of the pike population was younger than 5 years of age. In 1963-64, 84% of the population fell into this category. The structure of the pike population suggests this species is currently being harvested at a sustainable level.

10. The majority of walleye caught were larger than 30 cm in fork length, and were 3-4 years of age. In 1963-64, a 30 cm fish would have been 5-6 years of age. The absence of older fish, the rapid growth rate, and relatively large size of young fish in the current walleye population indicate these fish are subjected to very heavy fishing pressure. Perch and sticklebacks were the primary food items consumed by walleye.

11. Commercial fishing records for Pelican Lake are available since 1948. Number of commercial licenses issued since that time has ranged from 2 to 34. The commercial quota is currently 45 400 kg with a 10% tolerance limit on walleye, pike, and trout. Average annual production since 1984 has been 17 850 kg with 96% whitefish, 2.3% walleye, and 1.7% pike. Commercial harvest levels are low as a result of the high infestations of *T. crassus* cysts in the whitefish flesh.

12. The average annual Indian harvest since 1984 was estimated at 30 600 kg (3.0 $kg \cdot ha^{-1}$), comprised of 63% whitefish, 3.3% walleye, 6.7% pike and 27% other fish (cisco, burbot, perch).

13. Angler harvest in 1988 was estimated to be 36 720 kg (3.6 $kg \cdot ha^{-1}$, comprised of 44% walleye and 56% pike.

14. Macrobenthos standing crop was used to estimate the fish yield in Pelican Lake. The maximum sustainable yield of all species was estimated at 5.62 $kg \cdot ha^{-1} \cdot yr^{-1}$ and at 2.53 $kg \cdot ha^{-1} \cdot yr^{-1}$ for highly valued species. (walleye, pike, and whitefish)

15. A comparison of actual harvest with the estimated sustainable yield suggests that Pelican Lake provides a level of production well above the estimated MSY. However, further comparison to population data obtained from test nets indicates this applies only to the walleye population. The pike population appears to be at an optimum level of exploitation and the whitefish population is showing signs of being underutilized.

RECOMMENDATIONS

1. Retain the current commercial quota of 45 400 kg and the legal mesh size of 11.4 cm. Changes to these regulations will not, at this point, benefit the fish resources in Pelican Lake. In addition, restrict commercial nets to depths greater than 10 m.
2. Maintain the current level of recreational harvests of northern pike at 20 500 kg.
3. Reduce daily angling limits on walleye and enforce spring closure to angling in known spawning areas such as Medicine Rapids, Chachukew Rapids or Opawikusehikan Narrows.
4. Conduct a creel census and a Native fishery survey to obtain accurate information on the impact the recreational and Native harvests from Pelican Lake in both summer and winter seasons.

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8. APPENDICES

Appendix 1. Age and state of maturity of lake whitefish caught in gill nets in Pelican Lake in 1989.

Age (y)	Male		Female	
	Mature	Immature	Mature	Immature
1	0	0	0	0
2	1	5	1	2
3	4	9		3
4	3	10	8	2
5	16	2	16	
6	8	0	0	0
7	1	0	2	0
8	3	0	2	0
9	0	0	2	0
10	0	0	1	0
11	0	0	1	0
12	4	0	1	0
13	1	0	0	0

Appendix 2. Total number of fish and average length (centimeters) of fish caught per gillnet set in Pelican Lake in 1989. (mean depth in meters)

Net Set	Mean Depth	Whitefish No.	Whitefish Length	Walleye No.	Walleye Length	Pike No.	Pike Length	Cisco No.	Cisco Length	Perch No.	Perch Length	CWSucker No.	CWSucker Length	LNSucker No.	LNSucker Length	Burbot No.	Burbot Length
1	24.5	17	30.5	1	31.5	0	-	50	24.0	0	-	0	-	0	-	12	43.1
2	8.0	62	31.3	2	28.7	0	-	10	28.9	0	-	2	38.4	1	40.8	5	47.4
3	19.0	48	31.5	5	30.9	0	-	54	27.9	0	-	1	32.8	2	40.6	11	46.1
4	7.5	3	32.0	10	34.9	50	56.4	14	27.3	4	16.4	99	44.4	0	-	1	51.8
5	4.1	4	42.8	74	35.4	35	52.5	26	23.6	32	18.8	91	14.6	0	-	0	-
6	19.0	92	31.2	1	28.4	0	-	22	21.5	0	-	0	-	1	33.8	4	52.2
7	17.0	60	30.2	1	20.3	3	60.3	98	18.7	0	-	0	-	2	36.8	4	33.8
8	9.5	6	38.1	16	37.3	23	60.0	217	21.0	5	11.8	107	30.9	0	-	1	61.6
9	17.0	33	35.4	0	-	9	61.3	106	18.3	0	-	2	33.6	0	-	4	44.5
10	17.0	21	38.6	1	17.3	19	61.7	263	25.1	3	15.3	2	41.0	0	-	3	55.5
11	17.5	26	38.2	0	-	7	60.9	85	22.4	1	14.3	6	26.2	3	22.8	4	45.6
12	12.5	21	31.2	1	22.7	8	52.8	76	25.5	18	15.4	6	26.5	2	34.2	5	48.6
Total		393		112		154		1021		63		316		11		53	

Appendix 3. Age and state of maturity of northern pike caught in gill nets in Pelican Lake in 1989.

Age (y)	Male		Female	
	Mature	Immature	Mature	Immature
1	0	0	0	1
2	9	1	3	0
3	6	0	8	0
4	16	0	19	0
5	21	0	13	0
6	8	0	9	0
7	6	0	6	0
8	4	0	5	0
9	2	0	2	0
10	0	0	2	0
11	0	0	4	0

Appendix 4. Age and state of maturity of walleye caught in gill nets in Pelican Lake in 1989.

Age (y)	Male		Female		Unknown	
	Mature	Immature	Mature	Immature	Mature	Immature
1	0	1	0	2	0	3
2	0	4	0	4	0	1
3	0	8	1	15	0	0
4	1	15	2	9	0	0
5	2	3	3	8	0	0
6	3	0	2	3	0	0
7	0	0	0	0	0	0
8	0	0	2	0	0	0
9	1	0	1	0	0	0

Appendix 5. History of the commercial fishery production of Pelican Lake from 1948 to 1989 inclusive (weight in kilograms).

Year	Lake Whitefish	Walleye	Trout	Northern Pike	Other	Total	No. Licenses
1948-49	6896	80	219	-	-	7195	2
1949-50	6405	5387	207	279	-	12278	6
1950-51	7501	7806	177	1482	-	16966	11
1951-52	23955	983	266	1278	-	26482	25
1952-53	8705	774	201	399	-	10079	9
1953-54	126	494	5	271	-	896	3
1954-55	18330	267	7	111	-	18715	21
1955-56	no fishing						
1956-57	no fishing						
1957-58	5329	847	33	1632	-	7841	11
1958-59	no fishing						
1960-61	25788	392	67	426	-	26673	8
1961-62	24683	2134	75	4765	-	31657	12
1962-63	22870	1561	3	3002	-	27436	23
1963-64	32147	5037	-	10114	-	47298	19
1964-65	28674	5790	-	8121	-	42585	7
1965-66	33193	3503	-	3124	-	39820	15
1966-67	25256	9952	250	4934	-	40392	24
1967-68	30993	3399	1	3408	-	37801	30
1968-69	52847	435	-	741	-	54023	28
1969-70	45257	1512	-	3531	-	50300	34
1970-71	44387	1429	-	1552	-	47368	34
1971-72	27050	1138	-	1907	-	30095	36
1972-73	15730	394	-	101	-	16225	21
1973-74	9497	1391	-	671	-	11559	18
1974-75	21260	1881	-	973	21	24135	25
1975-76	13606	683	-	478	-	14667	16
1976-77	36524	1799	-	978	-	39301	29
1977-78	30444	1798	-	1177	-	33419	25
1978-79	27186	437	-	394	32	28049	20
1979-80	34569	254	-	835	-	35658	19
1980-81	38181	750	-	985	-	39916	28
1981-82	34743	740	-	1205	1	36689	22
1982-83	14280	271	-	217	-	14768	9
1983-84	18603	72	-	129	300	19104	21
1984-85	35082	517	-	314	-	35913	15
1985-86	20419	1045	-	803	-	22267	22
1986-87	559	4	-	26	-	589	3
1987-88	555	15	-	27	-	597	2
1988-89	28128	386	-	519	-	29033	13
Total	849758	65357	1511	6090	354	977889	666
% total	86.9	6.7	0.1	6.2	-	100	
Average	21243.9	1633.9	37.8	1522.7	8.8	24447.2	
kg/ha	2.1	0.16	-	0.15	-	2.42	

Appendix 6. History of the Indian harvest (kg) in Pelican Lake between 1984 and 1989.

Year	Lake Whitefish	Walleye	Trout	Northern Pike	Other	Total
1984-85	1500	200	-	100	-	1800
1985-86	2500	200	-	300	2000	5000
1986-87	2500	50	-	250	850	3650
1987-88	2500	50	-	100	600	3250
1988-89	800	50	-	50	500	1400
Total	9800	550	-	800	3950	15100
% total	65	4	-	5	26	
Average	1900	110	-	160	790	3020
$kg \cdot ha^{-1}$	0.19	0.01	-	0.02	0.08	0.30
Adjusted*	1.9	0.1	-	0.2	0.8	3.0

*From Murray and Clouthier, 1986